

Support 20 may also be a rigid plate or disk that is manufactured of metal, hard plastics or the like and is provided with perforations 22 or indentations.

Alternatively, cylindrical bores or perforations 22 in belt band 20 may be replaced by inwardly widening bores, recesses, etc. preventing the balls 38 from falling out. However, such design might enhance jamming and thus impede or delay the sucking-off of the balls in the removal station 50.

The outer dimensions of device 10 depend on the useful reading plane the size of which can be chosen arbitrarily and is preferably set to at least one text page. The upper face of device 10 is larger than the reading area by a framing margin. The overall height of device 10, which is rather flat, is defined by the drum size.

Important advantages of the invention are due to the pattern set-up by magnetizable balls 38 under magnetic field action, i.e. without moving parts. The speed of belt drive 34 and thus of support 20 during its forward motion in the feeding station 40 is coordinated with the control of solenoid actuation in the removal station 50 so that the ball set-up is brought about in a jiffy. The drive system including belt drive 34 is braked as soon as the final aperture row has been ball-filled according to the pattern programmed. The patterned support 20 will come to a standstill on the reading table (upper plate 14) and is available there without time limitation.

It is also favorable that the apparatus does not employ any substances that might exhaust or be used up. Moreover, there are no components of large temperature dependence. Power consumption is low, e.g. amounting to an average of 15 W only. It is of particular convenience that no periodic maintenance will be required, as the simple design warrants trouble-free operation; mean times between failures of the order of several thousand hours can easily be attained. Manufacture requires comparatively little time and material. If the volume of symbols to be displayed is to be increased, this will entail only minor additional cost.

While preferred embodiments have been illustrated and explained hereinabove, it should be understood that numerous variations and modifications will be apparent to one skilled in the art without departing from the principles of the invention which, therefore, is not to be construed as being limited to the specific forms described.

I claim:

1. A device for displaying patterns of small balls for braille reading purposes comprising in combination
 - (a) an endless belt containing a plurality of parallel rows of perforations,
 - (b) drive means to move said endless belt in a loop between two spaced apart drums,
 - (c) a ball feeding station located above the lower portion of the looped endless belt, which feeding station is adapted to deposit magnetizable balls in all of the perforations in the belt as the belt passes the feeding station,
 - (d) a ball removal station located beneath the upper portion of the looped endless belt, which station is adapted to selectively remove balls by electromagnetic means from certain of said perforations as the belt moves past said removal station,
 - (e) a reading area downstream of said removal station wherein the balls remaining in the perforations of the belt and which have a portion of each ball partially extending above the upper level of the belt can be read by tactile sensing of the balls,
 - (f) said ball removal station including a plurality of spaced apart electromagnetic means which are

adapted to cause the withdrawal of selected balls from said perforations with a force greater than gravitational force, and

- (g) electronic control means for controlling the said electromagnetic means so that the selective removal of balls from the perforations of said endless belt will result in a pattern of balls that will convey information to a person in the reading area.

2. Device according to claim 1 wherein said belt is enclosed by a flexibly engaging foil that is thin enough to permit tactile sensing of the ball pattern formed.

3. Device according to claim 1 wherein the drive means comprises an electric motor as well as a belt drive connected to one of the drums and wherein the sprockets are formed by elements seated in radial counterbores of the respective drum.

4. Device according to claim 1, wherein the ball feeding station includes collecting means for the balls comprising a chute that extends across the belt width.

5. Device according to claim 1 wherein the electronic control means provides for actuation of the electromagnets during part only of the time period required for moving the support across one ball spacing path.

6. Device according to claim 1 wherein the electronic control means provides for time-multiplexed interleaving of actuation of the electromagnets, successive transverse rows of which being actuated simultaneously with the respective support motion across one ball spacing path.

7. Device according to claim 1 wherein the ball feeding station is located immediately below the ball removal station and is associated with a filler magnet to insure filling of the perforations with balls.

8. Device according to claim 7 wherein the ball removal station includes electromagnets whose coil cores have axial passages of a clear width that at least slightly exceeds the ball diameter and wherein the bottoms of the coil cores are connected to the upper plate by magnetic flux return means.

9. Device according to claim 8 wherein the ball removal station comprises two apertured plates above each other which extend substantially across the belt width between the engaging hole tracks and which have rows of parallel bores.

10. Device according to claim 9 wherein the electromagnets and the bores of the apertured plates associated thereto are set off in a staggered array, the offset dimension in one direction equalling the ball spacing in the perforations of the support.

11. A method for displaying information in the form of patterns of small balls for braille reading which comprises

- (a) establishing a plurality of parallel rows of small magnetizable balls seated in an endless conveyor belt containing a plurality of parallel rows of perforations; all of said perforations being filled with said magnetizable balls,
- (b) moving said conveyor belt to a zone for the selective removal of some of said balls,
- (c) selectively removing some of said balls from said perforations in said zone with electromagnetic means, the force of which is greater than gravitational force,
- (d) controlling said electromagnetic means so that the selective removal of balls from the conveyor belt will result in a pattern of balls, and
- (e) moving said conveyor belt to a reading area for conveying information to an unsighted person via tactile sensing of the ball pattern.

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